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AGRICULTURAL MEMORANDUM NO 334

Effects of a rigid vinyl structure on the environment of a growing crop.

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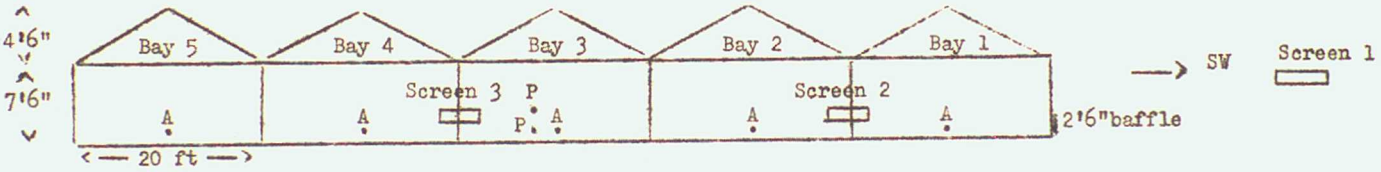
1. Introduction. At the request of the County Horticultural Adviser, Gloucester, as part of the normal advisory service, measurements of temperature, humidity and wind were made under rigid vinyl protected cropping units recently erected at the Land Settlement Association at Newent.

2. Details of Structures

2.1 The structures, made of wooden frames, have rigid, corrugated, clear vinyl roofs. The four sides are open, apart from lengths of plastic 2½ feet high along the two sides parallel to the ridges to prevent roof water splash. Lettuce and celery are grown under the structures and overhead spray lines are used for 'wetting down'.



Key: Screen - thermograph 10 March to 12 May 1970
- hygrograph 12 May to 12 June 1970
A - Anemometer point 21 May 1970
P - Aspirated psychrometer point 21 May 1970

2.2 The site of the structures is sheltered on three sides by hedges 8 feet high about 10-12 feet away. The site is, however, open to the south-west and a small screen (site 1) was erected on level unobstructed ground in this direction to house the thermograph and hygrograph. Two other screens were erected on the supports between Bays 1 and 2 (site 2) and Bays 3 and 4 (site 3).

3. Temperature

3.1 Thermographs were exposed in the three screens (3'6" high) for two months. Some of the traces were unreliable during the last few weeks but from the remaining charts it was possible to draw the following conclusions.

3.2 Maximum temperatures were on average about 3°F higher under the structures and on some days the increase amounted to 6-8°F. There was a tendency for site 3 to record higher maxima than site 2, probably because air movement was less, see 5.2.

3.3 Minimum temperatures at site 2 were 1½°F higher on average than those in the open at site 1, and the difference never exceeded 2°F.

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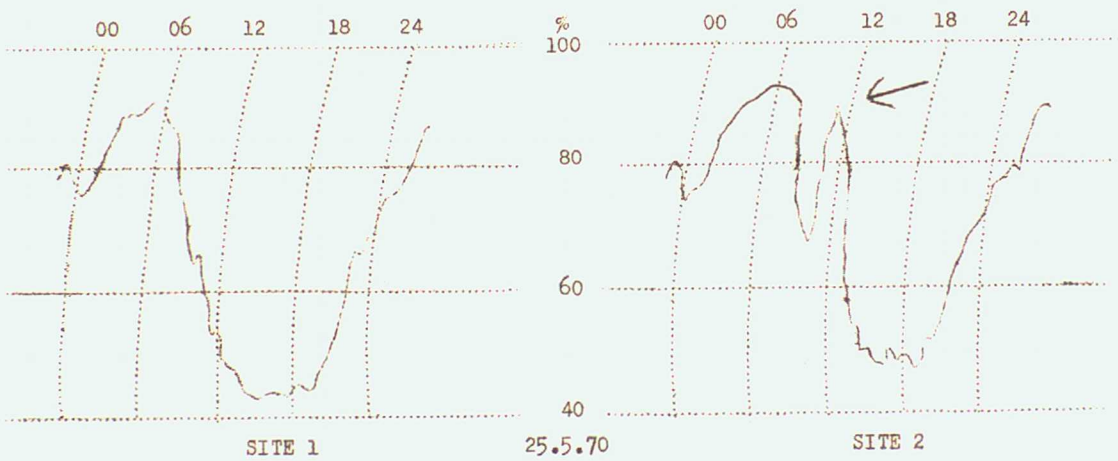
At site 3, however, the gain over site 1 was $2\frac{1}{2}$°F on average and on individual nights reached 3-4°F.

3.4 The use of thermographs in field trials is convenient, but too much reliance should not be placed on their findings (Cochrane & Hurst 1968). Ideally, thermometers should be used to confirm, or reject, the conclusions in 3.2 and 3.3.

4. Humidity

4.1 Hygrographs were exposed in the screens for a month following the thermographs. Within the accuracy of the instruments it was not possible to detect consistent differences at the two sites under the structures. However the influence of 'wetting down' was clearly evident on a number of days leading to an increase of 10-20% in the relative humidity. The duration of the increase varied from about 2 hours to 6-8 hours when more than one application of water had been made.

4.2 Example of wetting down:



To illustrate the effect of 'wetting down' on relative humidity.

4.3 On 21 May 1970 a series of temperature and humidity measurements were made using aspirated psychrometers at 3'6" and 9" above the ground in the middle bay, both before and after wetting down, with the following results:

	3'6" above ground		9" above ground	
Time	Temp.	Rel. Hum.	Temp.	Rel. Hum.
1200	54.1°F	59%	55.6°F	59%
1315	57.5	55	60.3	65
1330-1340	- wetting down by overhead sprinklers			
1345	53.8°F	67%	53.9°F	78%
1355	53.5	63	53.1	75
1405	55.0	65	56.0	72
1420	57.1	61	59.0	67
1435	54.3	61	54.1	76
1450	55.0	58	54.8	67
1505	54.5	60	54.3	74

4.4 The increase in relative humidity at plant height (9") following wetting down was maintained for at least 1½ hours at which time it was noticed that some leaves were still wet.

5. Wind

5.1 On 21 May a series of readings of run-of-wind at different heights were taken using sensitive anemometers. The unobstructed wind direction was about 290-300°, inclined at about 60° to the open end of the structure. The wind speed was generally 15-20 kts with gusts to 25 kts.

5.2 The following table gives the results obtained for individual runs, expressed as percentages of the unobstructed run-of-wind measured 120 ft (10h) away from the SW side.

Height above ground	Percentage of unobstructed wind measured in:				
	1st Bay	2nd Bay	3rd Bay	4th Bay	5th Bay
3 ft	63	39	33	25	18
3 ft	66	39	33	27	20
2 ft	57	35	28	24	19
2 ft	66	41	34	27	21
1 ft	56	31	25	20	17

6. Conclusions

The rigid vinyl structures at Newent have been shown to have the following effects:

6.1 Maximum temperatures - 3°F higher, exceptionally 6-8°F higher than in the open.

6.2 Minimum temperatures - 1½-2½°F higher, exceptionally 3-4°F higher, especially farther into the structure.

6.3 Humidity - No general differences except following 'wetting down' when increases of 10-20% in relative humidity were recorded. The increase persisted for several hours.

6.4 Wind - During W'ly winds the decrease in wind speed became progressively greater towards the farthest bay from the SW side, where reductions to about 20% of the unobstructed wind speed were recorded at 3, 2 and 1 ft above ground.

Reference:

J Cochrane and G W Hurst - Use of bimetallic thermographs in field experiments - Agric. Memo. No 247. October 1968.

Any comments or suggestions on this paper should be sent to the author.

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